# DESCRIPTION

# GRADER ATTACHMENT FOR A SKID STEER

## Cross-reference to Related Applications

This application claims priority to U.S. Provisional Patent Application Serial No. 60/421,339, filed October 23, 2002.

## Background of the Invention

**[0001]** Skid steer loaders are versatile machines which are virtually indispensable on many job sites. Skid steer loaders can move dirt and other materials and a skilled driver can use a skid steer to rough grade a surface. A skid steer cannot however provide full grading services. Fine grading requires a blade that can be rotated at the ground's surface and tilted into that surface.

**[0002]** Many grader and grader attachments have been described for skid steers and other equipment which attempt to address the maneuverability required for finish grading. For example, Meyer *et al.* (U.S. Patent No. 6,168,348 B1) describes a bi-directional surface leveling system which can be pushed and pulled across a surface to be graded. Several mounting systems have been described that allow the grader blade to be tilted and rotated (U.S. Patent No. 4,175,625, U.S. Patent No. 6,109,363, U.S. Patent No. 6,315,056 B1 and U.S. Patent No. 6,354,383 B1). Likewise, attachments for tractors, skid steers and other vehicles have been described, each attempting to address the need for fine grading. These references show graders that are pushed ahead of the powered vehicles (U.S. Patent No. 4,930,582, U.S. Patent No. 5,562398, U.S. Patent No. 6,168,348 B1, U.S. Patent No. 6,283,225 B1 and Japanese Patent No. JPO200102031A) or pulled behind a powered vehicle (U.S. Patent No. 3,716,105, U.S. Patent No. 4,898,247, U.S. Patent No. 5,289,880 and PCT International Publication No. WO 87/05350). None of these grader attachments however provide the full blade movement and precise control necessary to perform fine grading operations.

**[0003]** Therefore, a need remains for a grader attachment for a small machine, such as a skid steer, that allows that machine to perform with the precision and maneuverability required to complete fine grading operations. The grader attachment should allow the grader block to be rotated

across the ground and tilted into the ground. Further, blade position is important to complete fine grading and thus, the attachment should provide a means to accurately control the blade.

**[0004]** All patents, patent applications, provisional patent applications and publications referred to or cited herein, are incorporated by reference in their entirety to the extent they are not inconsistent with the explicit teachings of the specification.

## Summary of Invention

**[0005]** The subject invention involves a grader attachment for a vehicle. More specifically, the subject invention involves a grader attachment for a skid steer that provides precision control of a multi-positional blade through an independent steering device.

**[0006]** The grader attachment of the subject invention engages a skid steer loader using its standard mounting connection. The grader attachment utilizes the auxiliary hydraulics of the skid steer to power a hydrostatic steering system of the grader. The auxiliary hydraulics of the skid steer are also used to propel the skid steer and attachment as well as to control blade position. The auxiliary hydraulics of the skid steer are routed through a flow control valve and a hydraulic safety valve/back pressure valve. From the safety valve/back pressure valve, the hydraulics are routed to a main equipment valve to control blade position, a steering orbital to control skid steer and attachment steering, and through a back pressure/pressure reducing valve to a hydraulic remote foot control valve to control propulsion of the skid steer and attachment.

## Brief Description of the Drawings

**[0007]** **FIG. 1** is a top perspective view of a preferred embodiment of the grader attachment of the subject invention attached to a skid steer.

**[0008]** **FIG. 2** is a side elevational view of a preferred embodiment of the grader attachment of the subject invention attached to a skid steer.

**[0009]** **FIG. 3** is a top plan view of a preferred embodiment of the grader attachment of the subject invention attached to a skid steer.

**[0010]** **FIG. 4** is a hydraulic schematic of a preferred embodiment of a main hydraulic control valve of the grader attachment of the subject invention.

**[0011]** **FIG. 5** is a side elevational view of a preferred embodiment of the centering spring, travel cylinder and bell crank of the propulsion system of the grader attachment of the subject invention.

**[0012]** **FIG. 6** shows a preferred embodiment of a centering system for the travel mechanism of the grader attachment of the subject invention.

**[0013]** **FIG. 7** is a side elevational view of another preferred embodiment of a centering system for the travel mechanism of the grader attachment of the subject invention.

## Detailed Description of the Invention

**[0014]** The grader attachment of the subject invention utilizes the auxiliary hydraulics of the vehicle to which it is attached to control the propulsion and steering of that vehicle as well as to control the position of the grader blade.

**[0015]** In a preferred embodiment, the grader attachment of the subject invention attaches to a skid steer. Shown generally at **10** in FIG. 1, the attachment is securably mounted to the skid steer preferably using a standard mounting plate **12**. In a particularly preferred embodiment, the attachment is supplemented with a means by which to lock down the lift arm of a skid steer. For example, a hook can be attached to the skid steer and a hook can be attached to the grader attachment frame. The grader's main frame **14** is an elongated overarching beam extending from the proximal end attached to the skid steer at the mounting plate **12** to the distal end having an axle **16** for the grader wheels **18**. The frame **14** near the mounting plate **12** supports a seat **20**, a steering wheel **22** and a foot pedal **24**. An A-frame member **26** supports the blade **28**. In a particularly preferred embodiment, the frame has extensions **30** that support a shade canopy **32**.

**[0016]** It is known in the art that skid steers are controlled and maneuvered with a pair of hand control levers. Pushing the right hand control lever forward causes the right side wheels of the skid steer to move forward, while the left wheels remain stationary, thus the skid steer turns to the left. A right turn is accomplished by moving the left control lever forward. The skid steer is sent

in reverse by pulling back on the hand control levers. Hydraulics raise and lower the bucket and are controlled by foot pedals on the skid steer.

**[0017]** The grader attachment of the subject invention utilizes the auxiliary hydraulics of the skid steer to steer the vehicle and attachment, to propel the vehicle and attachment and to position the blade of the attachment. The auxiliary hydraulics of the skid steer are routed through a flow control valve and a safety valve/back pressure valve before being routed to power the steering, propulsion or blade control systems. The steering system and the propulsion system are tied to the hand controls of the skid steer. The blade control system rotates the blade about 27 degrees in each direction and tilts the blade into the soil.

**[0018]** The auxiliary hydraulics of the skid steer are routed through a flow control valve to regulate the flow of fluid presented to the systems. A safety valve/back pressure valve serves to stop hydraulic fluid flow to each of the steering, propulsion and blade control systems in the absence of the operator. A schematic of a preferred embodiment of this valve is shown in FIG. 4. The safety valve/back pressure valve comprises a 70 pound check valve **38**, at least two electric cartridge valves **42** and **43**, and a pressure reducing valve **41**. Pressurized fluid from the auxiliary hydraulics of the skid steer are routed to port **36**. The safety valve/back pressure valve is actuated by an extension of the ignition switch from the skid steer.

**[0019]** A seat safety switch **37** (for example, a standard 12 volt switch as required by OSHA) is connected to electric cartridge valves **42** and **43**. When there is no operator in the seat **20** of the grader attachment of the subject invention, fluid from the auxiliary hydraulics of the skid steer flows through valve **42** and tank port **46** to a tank. When an operator is seated in the seat **20** of the grader attachment, valve **42** blocks flow and fluid is directed toward the main equipment valve to control blade position and toward the steering orbital to control steering of the grader attachment and skid steer, and toward the foot controller valve to control propulsion of the skid steer and grader attachment.

**[0020]** Fluid blocked by electric cartridge valve **42** is checked by a 70 pound check valve **38** to create back pressure with which the foot control valve **47** and foot pedal **24** are operated. Fluid checked by valve **38** is delivered to a pressure reducing valve **41** which limits pressure to no more than 400 pounds. An electric cartridge valve **43** directs fluid to an reduced pressure (RP) port **44** to

supply pilot pressure to the hydraulic remote control (HRC) foot control valve **47**. Depressing the foot pedal **24**, affects the foot pedal control valve **47** which transfers fluid to a travel cylinder **48**. The travel cylinder **48** operates a bell crank **50** which strokes a travel rod **52**. The travel rod **52** is connected to a travel cross bar **54** (FIG. 3) that engages hand control connecting rods **56** which are quick-connected to the hand controls **58** of the skid steer. Preferably, the travel rod **52** is pivotally connected to the cross bar **54** to allow some independent movement of the hand control levers of the skid steer.

**[0021]** Fluid directed to the rod side **49** of the travel cylinder **48** retracts the rod within the cylinder putting the bell crank in the reverse position. The bell crank pushes the travel rod backward moving the skid steer hand controls **58** backward. The skid steer and attachment therefore move in reverse. Fluid directed to the butt side **51** of the travel cylinder extends the rod out of the cylinder which forces the bell crank into a forward position and the skid steer and attachment move forward. The skid steer and attachment move forward when the pedal **24** is depressed forward and backward when the pedal is depressed rearward.

**[0022]** A centering system returns the travel cylinder to neutral when the operator removes the foot from the pedal **24**, stopping movement of the skid steer and attachment. In a preferred embodiment of the centering system comprises a centering spring. A particularly preferred embodiment of a centering spring is shown in FIGS. 5 and 6. The centering spring **61** is operably connected to both the travel cylinder **48** and the bell crank **50** (FIG. 5). The centering spring comprises a rod assembly **62** within a spring **64** encased in a spring tube **66**. Spring seats **68, 70** rest against end caps **72, 74** which are attached, for example by welding, to the spring tube **66**. Preferably, the spring seats **68, 70** are made of aluminum to minimize wear. When in operation, the rod assembly **62** pushes on sleeve **63**, spring seat **68** is displaced and the spring **64** compresses (FIG. 6) when the foot pedal **24** is depressed in one direction. Removing a foot from the pedal allows the spring to expand seating the spring against the end cap **72**. When the foot pedal **24** is depressed in the other direction, the rod assembly **62** pulls the retaining nut **76** against spring seat **70** displacing it and allowing the spring to compress. Removal of a foot from the pedal allows the spring to expand, seating the spring against end caps **74**, leaving the travel cylinder in a neutral position.

**[0023]** Another preferred embodiment of a centering system is shown in FIG. 7. This system comprises centering springs, a travel centering bar and centering bearings. As the bell crank pivots about the bell crank pivot point **89** to its forward position, the forward centering bearing **90** engages and moves along a travel centering bar **92** causing the centering bar to pivot at the centering bar hinge **94**. When an operator removes his/her foot from the foot pedal **24**, the centering bar is forced to return to its rest position against the forward centering bearing **90** and a reverse centering bearing **96** by centering springs **98** and **100**. The centering bar moves the bell crank which puts the hand controls of the skid steer in a neutral position stopping the skid steer and grader attachment. The centering springs are attached to the grader on a centering spring bolt **102**. The bolt is threaded through a hole in a seat tube **104** and then through an enlarged hole in the centering bar. The inner centering spring **98** and the outer centering spring **100** are then threaded on the bolt and are retained by a spring retainer **106**, a washer **108** and a retaining nut **110**. The centering system likewise returns a bell crank that is in a reverse position to a neutral position stopping the skid steer and attachment as the centering springs act against the centering bar and bearings.

**[0024]** The blade **28** of the grader attachment of the subject invention can be rotated 27 degrees in each direction and tilted into the ground. Fluid checked by the 70 pound check valve **38** of the hydraulic safety valve/back pressure valve is directed to a main equipment valve. The main equipment valve **82** directs pressurized fluid through control levers **84**, to the blade lift cylinders **86**, the blade angle cylinders **88** and additional blade adjustment assemblies. Additional blade adjustment assemblies can include, for example, cylinders which allow the blade to be tilted forward and back and shifted side to side across the surface of the ground.

**[0025]** The main equipment valve **82** also has a main relief valve and a power beyond plug to channel hydraulic fluid to the steering orbital **78**, and steering cylinder **80**. When the steering wheel **22** of the grader attachment is set in motion to the right, the cylinder retracts. The front wheels **18** of the attachment turn to the right and the wheels of the skid steer follow, turning the skid steer and attachment to the right. When the steering wheel **22** is set in motion to the left the cylinder extends, turning the front wheels to the left, and the skid steer and grader attachment turn to the left. The independent steering system of the grader attachment of the subject invention allows the operator to sit above the blade **28** where the blade can be controlled with precision and accuracy.

**[0026]** It is understood that the foregoing examples are merely illustrative of the present invention. Certain modifications of the articles and/or methods employed may be made and still achieve the objectives of the inventions. Such modifications are contemplated as within the scope of the claimed invention.